MANAGEMENT HANDBOOK

To Aid Emergency Expansion of

Dehydration Facilities for Vegetables and Fruits

VOLUME II

BEET SUPPLEMENT

A Phase II Preparedness Study

Prepared at the Request of
Office of the Quartermaster General
Department of the Army
Washington, D. C.

By

Western Regional Research Laboratory
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
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BASIC ASSUMPTIONS

Foreword

The planning of a dehydration plant meeting national emergency needs should take full cognizance of the information and suggestions given in Volume I of this Handbook. This set of plans for a beet dehydration plant is based upon the principles set forth in that portion of the Handbook.

Product Desired

The plant covered by this section of the Handbook is designed to produce dehydrated beet dice (Type I) in accordance with the Military Specification "Beets, Dehydrated" (MIL-B-3024) dated 3 August 1949.

Bases for Operations, Facilities, and Cost Estimates

A. Location of Plant

During the 10-year period of 1940 through 1949, the largest producing area for table beets was in Wisconsin, followed very closely by areas in New York. Other substantial beet producing areas are in Texas, Oregon, Pennsylvania, New Jersey, and Michigan (see Table II in Chapter II). Although any of these areas is suitable for location of a beet dehydration plant, these plant plans and estimates are based on the arbitrary selection of Wisconsin for the plant location. The general plan, design, and operations are applicable, however, to plants located in other areas.

B. Operating Basis

Design and cost estimates are based upon an operation of three 8-hour shifts per day, six days a week, and 100 operating days a year.

Labor costs are based on rates calculated from typical labor rates in Wisconsin for unskilled labor adjusted to the bracket classification used in the other dehydration plant plans. Although these adjusted rates may, in some cases, be higher than those actually paid in the proposed plant area, this procedure puts the various plants in this Handbook on a comparable basis for cost estimation purposes.

The labor rates used in this set of plans are as follows:

Class Labor	Hourly Rate (40-hr. wk. basis)
1	$1.50
2	1.30
3	1.20
4	1.10
5	1.00
6	0.90

C. Raw Commodity Used

It has been assumed that the beets used in this plant will be of the varieties having characteristics desirable for dehydration. As shown in Table I, these varieties will include Detroit Dark Red, Morse Detroit, Ohio Canner, and possibly several others. Beets ordinarily should be dehydrated immediately after harvesting; therefore it is assumed that this plant will commence operation at the beginning of the harvest season in late July and continue until early November, or until frosts end the harvest season. This would allow a total of approximately four months of operation. Extension of the processing season by dehydrating raw commodity which has been stored is also possible, if necessary to fill out the 100 operating-day processing season which has been assumed.

Provision has been made in the cost estimates for raw commodity prices ranging from $10 to $40 per ton.

D. Plant Capacity and Yields

This plant has been designed to have a normal processing capacity of 100 tons per day of raw beets. Plant capacity is based on 24 hour per day operation of the dicers, blancher, dehydrators, and bin driers, but only 20 hour per day operation of the remainder of the plant.

The over-all shrinkage ratio for this plant is assumed to be 13:1 (actual shrinkage ratios may fall in range 10:1 to 15:1). On the basis of a 13:1 over-all shrinkage ratio, 100 pounds of raw beets yield 7.7 pounds of dehydrated diced Type I product. In addition, it is assumed that 0.4 pounds of "fines" and 0.4 pound of "defects" will be produced. It is also assumed that there is no market for the "fines" and "defects", and they will be hauled away with the other plant wastes.

E. Storage Space

Storage space in the plant building is provided in this set of plans for handling a raw beet supply equivalent to 2 to 3 days of plant operation, without stacking the pallets of beets, and without unloading the sacks of beets from pallets. If more space is required, the beets may be held outside, or the sacks stacked inside the building until processed. Space also has been provided for storage of a 40-day production of packaged and cased dehydrated beet dice plus a 10-day supply of empty cans and cases, or any desired combination of these items.

F. Waste Disposal

It is assumed that the beet trimmings, about 20 tons per day, will be hauled away at a cost of $2 per ton.

CHAPTER II

SUPPLY OF RAW BEETS

Characteristics Desired in Raw Products to be Dehydrated

Military specifications for beets for dehydration call for clean, sound, mature roots of tender texture when cooked. They should be of a dark red variety substantially free from light rings or zones.

Canners desire a high proportion of small size beets because they can be canned whole and, as such, bring high prices. Dehydrators, on the other hand, will desire the larger sizes because of the higher over-all yield and the lower labor costs in the preparation line. Inferiority in color and the possibility of over-mature woodiness must be guarded against when large sized beets are used. The specifications call for beets of U. S. No. 1 grade, except for size. Beets for dehydration are usually harvested when two and one-half to three inches in diameter. Beets for processing must not be wilted or flabby and not be fibrous, woody or tough. The beets shall be free from any injury or defect which materially affects the processing quality or cannot be removed in the process of peeling without excessive waste. The tops are cut or torn off to within one inch of the crown of the root.

Suitable Dehydration Varieties and Commercial Production Data

Detroit Dark Red, Morse Detroit, and Ohio Canner are reported as being excellent varieties for dehydration use (see Table I). Other varieties of table beets also may be used for dehydration.

Table beets are grown in some States principally for processing (canning), and in some States the commercial crop is largely for fresh market use. About two-thirds of the reported crop is processed. Only eight States have an average table beet acreage in excess of five hundred acres. Three widely separated States -- Texas, New York and Wisconsin -- account for well over half of all commercial acreage and production (see Table II). In Oregon, table beet growing and canning is comparatively new and grew rapidly during the World War II period.

Procurement Problems

A. Supply of Seed

To supply a 100-ton per day dehydrator for 100 days, approximately 1,000 acres of beets would be needed. Even when the maximum of 15 pounds of seed per acre is used in planting, the required seed of 15,000 pounds would amount to less than 3% of the current production of the Detroit varieties (see Table III). Table beet seed can be planted immediately after it is grown and cleaned; or, if it is stored properly, it will remain viable for four or five years, although, as a rule, it is not advisable to plant seed that is more than two years old.

B. Soil, Fertilizer, and other Cultural Requirements

Season of the year in which the crop is grown, weather conditions, and cultural practices all have their effect on the color of beets. Beets maturing in a period of decreasing temperatures such as occurs in the fall, usually are darker and have smaller and less distinct white zones than those harvested in the heat of summer. Also, it has been observed that the largest roots in any given harvest usually have the poorest color (contain the most white flesh), and the smallest roots are the best in color. Fall grown beets are therefore better for meeting the military specifications.

Deep sandy-loam soils give best results in beet growing, but for midsummer and fall crops the heavier soils can be advantageously employed although some misshapen roots result.

Table beets should not be planted on land immediately after a heavy cover crop has been turned under, for the decaying cellulosic material will rob the beets of the required nitrogen unless supplemental nitrogen is added. Where these crops are plowed under at least a year in advance of seeding, the land will be suitable for planting beets.

The table beet is very sensitive to deficiency of boron in the soil, which may result in poor growth or internal black spot. This physiological disease may be avoided by the proper use of borax. The beet is also very sensitive to soil acidity. Soil that is more acid than indicated by a pH of 6.0 should be limed before planting beets. Competent advice should be secured when contemplating the use of soil chemicals.

Before beets are planted, the soil should be carefully prepared. The soil should be free from all rough material and should be pulverized to a depth of several inches. If the soil packs or forms a crust after a rain, the young beets will have difficulty in breaking through to the surface.

The seed, 6 to 15 pounds per acre, is usually covered to a depth of one-half to one inch, depending on the texture of the soil. With good germination, the stands may require thinning when the plants have 3 or 4 leaves, to give a spacing of 2 to 3 inches between plants. Growers of beets for processing try to seed sparingly to avoid the expense of thinning. Weeds should be kept out of the fields by early shallow cultivation, and cultivation may be discontinued when the plants are half-grown.

C. Harvesting and Storing

For canning or dehydration the beets are usually harvested at a stage agreed upon by the processor and grower. The beets are topped as they are pulled, and then hauled to the processing plant in bulk, or in sacks, crates, boxes, etc. The tops may be removed mechanically before the beets are harvested.

Beets are ordinarily processed within a few days after digging. However, in Wisconsin, New York, and other eastern beet processing States, some storing is practiced. Beets grown for winter storage are allowed to remain in the field until just before the first hard frosts. Then they are pulled and topped. They are stored in banks, pits, or cool, moist cellars. The storage temperature should be 32° F. to 40°F. with about 95% humidity, to minimize softening and shrinkage. Dehydrators of World War II found that the dehydrated product cost about one cent per pound more when made from beets held in storage.

D. Competing Outlets for Raw Beets

The chief competing outlet for fresh beets is the beet cannery. There is not the large scale movement of beets to the metropolitan fresh markets that is found in the case of other vegetables dehydrated for military use, for the beet is one of the less popular vegetables. Only in New Jersey is there important production of beets both for fresh market and for processing. It is possible that existing beet canneries, by installing dehydration equipment, could supply all the dehydrated beets required. Contract-growers now supplying the canneries could greatly increase their yields by harvesting a larger beet than required for canning. This was done during the World War II period.

E. Competition with Other Crops for Acreage

Other crops offer serious competition with beets for acreage. The returns per acre are insufficient to displace the growing of other vegetables, such as lettuce, onions, and cabbage. During the World War II period there was an increase in the acreage of beets for processing.

F. Considerations in Obtaining Beets

It is probable that the raw commodity will be grown in the same area and by the same growers now supplying beets for canneries. In the first year of an emergency it would be feasible for the raw commodity contracted for canning to be diverted to dehydration plants in, or near, the present canneries. Field men trained in procurement of canning beets can assist the growers in producing high quality beets for dehydration.

TABLE I

Characteristics of the Principal Commercial Varieties of Table Beets

Variety 1/	Quality Score 2/	Flesh Color 3/	Light Rings or Zoning 4/	Solids Content (%) 5/	Root Depth 5/ (Inches)	Root Weight 6/ (Ounces)	Days to Maturity 7/	Chief Use	Other Common Names
Crosby Egyptian	Good	Dark Reddish Purple 8/	Distinct	19	1 3/4 - 2 1/2	4 - 6	75 - 90	Bunching	Crosby; Crosby's Early Blood Turnip
Early Wonder	Good	Dark Reddish Purple 8/	distinct	17	2 1/4 - 2 3/4	5 - 7	77 - 92	Bunching	Boston Crosby; Nuttings Gem
Detroit Dark Red	Excellent	Dark Red	Indistinct	20	2 3/8 - 3 1/8	5 - 9	80 -95	Canning 9/	Detroit Blood Red; Detroit Blood Turnip
Morse Detroit	Excellent	Dark Purplish Red	Indistinct	19	2 1/4 - 2 3/4	6 - 7	80 - 95	Canning 10/	Short Top Detroit; Improved Detroit
Ohio Canner	Excellent	Dark Red	Very Indistinct	19	2 - 2 1/3	- - -	90 - 100	Canning 11/	- - - -
Long Dark Blood	Good	Dark Red	Indistinct	23	8 - 12	7 - 11	80 - 100	Long Island N. Y. Market	Early Long Blood; Improved Long Dark Blood

1/ These six varieties constitute over 80% of table beets grown in the United States
2/ Based on color, texture, and flavor of reconstituted cooked samples of dehydrated product from beets of late fall harvest at Beltsville, Maryland
3/ Military Specifications call for dark red varieties, free from light rings
4/ All varieties have light rings, but these become very narrow and less distinct in the fall crops grown in cool weather. Fall crops will more nearly meet specifications regarding light rings
5/ Based on samples dehydrated by Caldwell, Culpepper, and Hutchins at Beltsville
6/ Root depth and weight pertains to roots 2 1/2 to 3 inches in diameter, grown for processing
7/ Period from emergence of seedlings until roots reach 2 1/2 to 3 inches in diameter, when grown as a late fall crop in the northern States. Growing period is shorter for earlier crops
8/ Color fades badly in processing
9/ Preferred for canning as diced or sliced beets
10/ Preferred for canning as whole beets; does not attain the size of Detroit Dark Red. With Detroit Dark Red comprises the bulk of the crop for canning purposes
11/ Of relatively minor importance in the canning industry

Sources: Magruder, R., and others. Descriptions of Types of Principal American Varieties of Red Garden Beets. Washington, D. C. 1940 (U.S. Dept of Agriculture Miscellaneous Publication 374) 59 p.
Caldwell, J. S., Culpepper, C. W., and Hutchins, M.C. "Varieties of Beets Suited to Dehydration". In: FOOD PACKER 25 (9): 47-49; (10): 44-48. Aug. - Sept. 1944.

TABLE II

Table Beet Production, Yields, and Prices for Principal Producing States

Utilization and State	Ten-year average - 1940 through 1949 Production (Tons)	Acreage (Acres)	Yield (Tons/ Acre)	Price ($/Ton)	1950 Price ($/Ton)	1951 Price ($/Ton)
For Fresh Market 1/						
Texas	27,800	7,560	3.7	19	27	42
New Jersey	9,800	1,550	6.4	44	54	50
Pennsylvania	10,900	1,100	9.9	38	40	46
For Processing						
New York	41,800	4,590	9.0	20	20	20
New Jersey	5,400	620	9.0	21	23	25
Michigan	7,200	1,070	6.6	17	19	19
Wisconsin	43,300	5,300	8.0	16	20	20
Oregon	16,400	1,600	10.1	20	22	23
United States:						
For Processing	129,100	16,010	7.9	18	21	21
For Fresh Market	55,200	11,630	4.8	31	42	51
U. S. Total	184,300	27,640	6.7	22	27	30

1/ Most fresh market statistics are reported in bushels of approximately 52 pounds

Sources: U. S. Bur. of Agric. Economics. Commercial Truck Crops...Annual summary... for fresh market, 1951, Washington, D. C. 1951 (Dec.)
U. S. Bur. of Agric. Economics. Commercial Truck Crops...for commercial processing, 1951, Washington, D. C. 1951 (Dec. 17)

TABLE III

Production of Table Beet Seed by Varieties 1/

Variety	1948 (lbs.)	1949 (lbs.)	1950 (lbs.)	1951 2/ (lbs.)
Crosby or Early Wonder	216,700	612,100	172,500	157,700
Detroit, Short top	309,000	667,800	393,100	275,400
Detroit, Standard	75,200	149,600	212,900	356,000
Flat Egyptian	93,800	45,200	3,700	5,000
Other Varieties	187,400	406,000	274,600	218,300
Total	882,100	1,880,700	1,056,800	1,012,400

1/ Production by 130 commercial growers who usually have accounted for about 95 per cent of the total commercial crop in the United States

2/ Indicated by grower intentions

Source: U. S. Bur. of Agric. Economics. Acreage and Production of Vegetable Seeds, 1948-49, 1949-50, 1950-51, Washington D. C., 1950 (Jan, May) - 1951 (Apr.)

TABLE IV

Usual Planting and Harvesting Periods for Table Beets in Principal Producing States

State	Planting	Harvesting			Growing Districts
		Begins	Most Active	Ends	
Texas	Sept.1 - Jan 31	Nov.10	Dec.15 - Apr.30	May 31	Southern
New Jersey	Apr. 1 - July 10	May 25	June 1 1/- July	Oct.31	Bergen, Passaic, Morris, Cumberland and Manmouth Counties
Pennsylvania	Apr.15 - July 31	June 1	June - Oct.	Nov.30	Eastern
New York	May 20 - July 31		Aug. 1 1/	Nov.30	Western and Southeastern
Michigan	May 20 - July 31		Aug. 1 1/	Nov.20	Southern
Wisconsin	May 10 - July 31		July 20 1/	Nov.30	Southeastern
Oregon	May 1 - July 31	July 1	July 1 1/-Sept.30	Oct.15	Williamette Valley

1/ Dates on which canning season usually opens

Source: U. S. Bur. of Agric. Economics. Commercial Truck Crops for Fresh Markets: Usual Planting and harvesting Dates and Principal Producing Areas by Seasonal Groups and States. Washington, D. C., 1951 (May)
Canning Trade Almanac 1950 (35th annual) : being CANNING TRADE 72 (52,pt.2), July 17, 1950

Other Sources of Information

Beattie, J. H. The Culture of Table Beets Rev. ed. Washington, D. C., 1943 (U. S. Dept. of Agriculture Leaflet 127) 4 p.

Caldwell, J. S., C. W. Culpepper, and M. C. Hutchins "Varieties of Beets Suited to Dehydration". In: FOOD PACKER 25 (9): 47-49; (10): 44-48, Aug. - Sept. 1944

Lorenz, O. A., and P. A.,Minges. Table Beet Production in California, Rev. ed. Berkeley, Calif., Agric. Extension Service, 1948. 5 p.

Magruder, R., and others. Descriptions of Types of Principal American Varieties of Red Garden Beets. Washington, D. C. 1940 (U. S. Dept. of Agriculture miscellaneous Publication 374) 59 p.

CHAPTER III

PLANT PROCEDURES AND FACILITIES

This section gives pertinent information concerning the operating procedures and the facilities required for the beet dehydration plant. The information is classified and presented in accordance with the classification key given in Appendix D ("Operation Classification Code") in Volume I. The accompanying flow-sheet, drawings of equipment and facilities, and other illustrative material have been labeled in accordance with this same classification. (Note: This same classification key has been used in compiling the "Cost of Facilities" and "Total Production Costs", and thus affords a useful cross-reference system for identifying or discussing any phase of the operations and/or costs.)

The operational procedures and other facilities needed for this proposed beet dehydration plant are presented in accordance with the attached flow-sheet (Figure 2). A floor-plan (Figure 3) is given to show the space and arrangement required for the facilities.

100 -- RAW MATERIALS

The problems and methods of procuring a suitable supply of beets for a dehydration plant have been discussed in "Supply of Beets" elsewhere in these plant plans.

200 -- MANUFACTURING OPERATIONS

210 -- Raw Material Handling

211 -- Weighing

It is assumed that the truckloads of beets will be weighed at the plant.

212 -- Unloading and storing at the plant

Beets for processing are handled in sacks, crates, lug boxes, baskets, and in bulk. In the plant described here it is assumed that the beets will be handled in sacks holding 50 pounds each, and that the sacks will be palletized with 40 sacks (1 ton) to the pallet. Sacks and pallets have been provided for holding a 5-day supply of beets at the plant. Also, as additional 5-day supply of sacks has been provided for field supply.

It is assumed that the processor receives the raw material directly from the field. No provision is made for storage of beets in the plant other than for that quantity which is required to assure a steady flow of raw material into the processing line.

213 -- Feeding to line

A plant processing 100 raw tons per 20 operating-hour-day will require feeding 5 tons per hour. Operators will feed 10 sacks every 3 minutes into the hopper of the first elevator. One or two women may be stationed alongside the first elevator to sort out "rots". This is especially desirable toward the end of the processing season when raw commodity quality is low.

215 -- Handling and returning sacks

The empty sacks are returned to the field for refill, or are stored until the next season. The usual precautions must be taken to keep the sacks dry, especially before storing for any length of time, to prevent mildew damage of the sacks.

220-230 -- Preparing

A diagrammatic sketch of the "preparation line" for the proposed beet plant is given in Figure 4.

221 -- Washing

For very dirty beets, sprays may be installed over the elevator for preliminary washing or loosening of dirt. Although not specified in this plant, "dry washers" are frequently recommended for use on dirty beets when water supplies are limited or costly, or when price adjustment must be made for the weight of dirt in the sacks of raw commodity. Dry washers are essentially the same design as rotary "wet" washers except that no water sprays are used. The beets are tumbled in a horizontal rotary screen- or slatted-drum, the loosened dirt falls onto a conveyor belt or directly into containers, and the beets proceed to the wet washer. In these plans the wet washer is of the rotary rod-type, where the beets are tumbled while exposed to sprays of water.

222 -- Preheating

Preheating of beets before steam peeling reduces the load on the peeler and allows more flexibility in adjustment of the peeling conditions when beets which have unusual peeling characteristics are processed. Most processors of beets during World War II employed some form of preheating ranging from short light heating to long pressure retort cooking. In the latter cases, blanching after dicing was unnecessary.

In this plant a rotary-type preheater is specified. Rotary-type machines offer economy of floor space. A machine similar to the lye peeler illustrated in Figure 6 may be used with the steam coil section removed and provision made for direct steam injection.

223- Peeling Steam

223.3 -- Peeling

Peeling losses are assumed to be 10%. Poor grades of beets may run up to 20%; top grades may run as low as 5%. An incomplete peeling job will result in lower peeling losses, but this will be off-set by higher trim and inspection loss, and by increased preparation labor cost.

Steam peeling has been provided in the proposed plant. The steam peeler is generally operated at 70 to 100 p.s.i. for

60 to 85 seconds exposure time. Optimum operating conditions must be determined by test on each new batch of raw commodity.

Other peelers which have been used successfully on beets are of lye, flame, and abrasion types, combined with various degrees of preheating. The abrasion methods involve high peeling losses, but require somewhat less water for washing. Flame peelers are good, but may be costly. Lye peeling is known to be a reliable method, but involves such problems and disadvantages as:

(a) Penetration is deeper and hence peeling losses are higher

(b) Corrosiveness and health hazard of lye must be considered

(c) Disposal of spent lye may be bothersome

(d) Trimmings from lye-peeled beets are not suitable for stock-feed unless given considerable washing

(e) Thorough washing of product is necessary to remove last traces of lye

(f) Lye storage and make-up facilities must be provided

(g) During an emergency, shortage of lye, steel drums, tank cars, etc., may limit operations

(h) Laboratory control is necessary with lye-peeling

Notwithstanding these disadvantages, lye is still used by some plants because it is known that with proper selection of peeling conditions it will always do the peeling job.

223.9 -- Washing

This washing step is actually the finishing step for the peeling operation. Skins which have been loosened in the peeler. are washed off by water sprays while the beets are being tumbled. The washer specified in this plant is actually an Urschel abrasion peeler, except that the rolls are rubber-covered instead of carborundum-coated. Sometimes it is advisable to use one or more abrasive-covered rolls to give the beets a "kick". Also, with difficultly-peeled beets, abrasive-covered rolls may be added or removed as required to do an adequate peeling job without excessive peeling losses. The most efficacicus procedure can best be determined by trial.

224 -- Trimming

The trimming tables included in these plans are of the "merry-go-round" type. The trim line will require about 45 women, more or less, depending upon the grade of raw material. A small trough of running water is furnished under each side of trim table for fluming away trimmings and for trimmers to wash off hands and trimming knives.

Trimming losses have been estimated to be 15%. Actual trimming losses may vary from 5% to 25%, depending on raw commodity quality and the peeling efficiency.

226 -- Holding, elevating, dicing

The nature and relationship of the blanching and drying operations require that a steady source of prepared material be available for continuous 24-hour operation. Holding hoppers must therefore be provided after the trimming line capable of holding prepared commodity equal to one-half to one hour of operation. This will help smooth out irregularities or interruptions at any stage of the processing line. A total of approximately 75 to 150 cu. ft. of hopper capacity is required. These hoppers may be custom-built, or may be furnished by the equipment manufacturer supplying the elevators feeding the cutters.

Beets for military use are cut to 3/8" x 3/8" x 3/8" dice, or 3/16" x 3/8" x 3/8" half-dice. The smaller size gives higher drying rates and greater production capacity per dehydrator. At least one ex- extra cutting machine and plenty of spare parts are needed to assure maximum and continuous production.

227 -- Spreading and blanching

For blanching, the diced commodity is loaded directly onto the blancher belt at about 4 lbs. per sq. ft. (approximately 1" deep) and exposed to steam at 200°F. to 210°F. for 5 to 7 minutes. A vibrating blancher-loading device is included to maintain a uniform layer of material across the full width of the blancher belt. This is necessary to provide equal and uniform loading on each of three conveyor belts feeding the driers. The product discharged from the blancher drops directly onto the three belts.

240 -- Drying

Beets may be dried successfully in either truck-and-tunnel or continuous-conveyor-belt dehydrators. Continuous-conveyor-belt dehydrators were chosen for this proposed plant for several reasons:

(1) Beets are well suited for a conveyor drier operation:

(a) Diced material is uniform in shape and size, and thus may be loaded in a layer of uniform depth and consistency

(b) Diced beets may be dried in deep beds and with high temperatures (do not scorch easily)

(c) Diced beets are not likely to fracture under the conditions of handling in a conveyor dehydrator

(2) Beets were successfully dehydrated in a continuous-conveyor-belt dehydrator during World War II.

242 — Conveyor drying

242.1 -- Conveying and spreading

Three separate rubber-belt conveyors are specified for feeding the driers with material from the blanching operation. These belts will discharge directly onto the cross-conveyor furnished by the drier manufacturer for feeding and spreading for each drier.

242.2 -- Conveyor drier operating

Dehydrated beets were successfully prepared for military requirements during World War II in both truck-and tunnel and continuous-conveyor-belt dehydrators. One operator, using a continuous-conveyor-belt dehydrator, produced 220 pounds per hour of 3/8" x 3/8" x 3/8" beet dice containing 5% moisture. The three dehydrators proposed for this operation are of similar design. The output required for each of these dehydrators, based on 24-hour operation, 1/ is 250 pounds per hour of beets cut to 3/8" x 3/8" x 3/16" size and dried to approximately 11% moisture. The greater drying rate resulting from the smaller cut size, and the higher moisture content permitted in this particular end-product (11%), should assure the required capacity to be achieved without difficulty in the three dehydrators specified.

The driers proposed (see Fig. 5) have two drying stages, ("A" and "B" stages). The six units (one unit consists of the section served by each circulating fan and heating bank) in stage "A" may be operated as three sections consisting of 2 units per section, or as two sections consisting of 3 units per section. All of the units within a section operate at the same temperature. The two units in stage "B" operate at a common temperature. Hot-end temperatures (in stage "A") have been reported in the range 200°F. to 210°F., and finishing temperatures (in stage "B") around 160°F. For maximum production of acceptable product, optimum operating conditions must be determined on the particular type of raw material being processed.

242.3 -- Conveying and elevating

The products of the three driers discharge onto a cross-conveyor collecting belt, and are then elevated to a hopper-bin feeding the portable finishing bins.

248 -- Bin drying

The use of bins for finishing-drying definitely improves the flexibility of the drying operation. In this operation, where continuous conveyor belt dehydrators are used, bins allow closer control in meeting moisture specifications. Also, in effect, this procedure provides relatively simple and inexpensive equipment to assume part of the load of the more costly conveyor driers.

The proposed beet plant uses portable bins and a bin room designed on the basis of the following data:

1)	Air flow rate through bins	- 80 c.f.m. per sq. ft. of cross-section
2)	Inlet air temperature to bins	- Approximately 145°F.
3)	Drying time	- 6 to 12 hours
4)	Bulk density of dried beet dice (approx. 11% moisture content)	- Approximately 22 lbs. per cu. ft.
5)	Depth of material in bins	- 4 feet

1/ 24 hour operation of the dehydrators is required so that a continuous and uniform layer of material is maintained on the dehydrator belt to prevent air from short-circuiting around the open spaces and to maintain uniform drying of the product.

248.1 -- Bin loading

The design of the portable bins is shown in Figure 7. The dimensions of these bins are 3 ft. wide by 5 ft. long by 5 ft. high.

248.2 -- Bin operating

It is anticipated that six to eight bins will provide adequate capacity for plant production when atmospheric conditions are normal. Space and outlets are provided for a total of eight bin-stations on the heated-air duct. Two extra bins are provided for loading and unloading. A suggested arrangement for the bin room is shown in Figure 3.

248.3 -- Bin unloading

The bins are unloaded, by lifting with an electric hoist, into the hopper which feeds the screening operation.

250 -- Screening and Inspection

252 -- Screening

Military specifications require that not more than 1% by weight of the dehydrated product may pass through a U. S. Standard sieve containing 8 meshes to the inch (0.0937 inch openings). Screening is therefore required to remove the material that is too fine in size to meet these requirements. (In some plants operating on various vegetables a magnet is installed also at this point to remove metallic iron contamination from the product.) The "fines" produced in this plant have been assumed to be 3 to 5%, based on the original raw material processed. With good operating procedures, "fines" may run as low as 1%.

255 -- Inspecting

After being screened, the product is inspected for discolored pieces, peel fragments, etc. The inspection is done while the dehydrated and screened product is carried along a continuous conveyor belt going to the packaging operation. "Defects" have been estimated to be 3.5%, based on the original raw material processed.

260 -- Packaging and Packing

261 -- Filling, weighing, and closing

In this plant, the rate of handling of cans is low (280 per hour) and expensive automatic equipment to fill and weigh the cans is not justified.

In the proposed filling operation, cans are fed manually into the can run, and then automatically placed in register with the can-filling opening. The entire can-carrying table revolves, as well as the center bowl carrying the product to be packaged. The product is manually brushed into the filling openings by the operators. The feed bowl is filled by operating a gate on an overhead hopper.

The filled cans are conveyed from the filling machine past two manual weighing stations, and continue on to a conventional closing machine. The specifications require that a leaflet giving cooking directions be placed in each can. Some saving in labor may be effected by having the people work intermittently on filling, weighing, and closing operations, and by shifting personnel from the dried product inspection line as required.

Cans should be purchased with lithographed labels as required in the specifications. The date is stamped on each can at the time of packaging.

262 -- Case forming, filling, sealing, and marking

Specifications permit the use of either wood boxes or fiberboard cartons of definite types; the military bids and contracts will specify the exact types of packing to be supplied by the dehydrator. Present-day dehydrators use either mechanical or manual casing operations.

270 -- Warehousing and Shipping

In keeping with the current trend, the proposed plant utilizes pallets for handling and storing of the finished product in the warehouse.

GENERAL FACILITIES

The requirements for other needed facilities have been discussed in Volume I, and the information will not be repeated here. The principal "general" facilities for the beet plant are listed in the "Cost of Facilities" for this proposed plant; included are items for utilities, maintenance and repairs, inspection and control, miscellaneous plant facilities, automotive, and administrative facilities and supplies.

325 -- Waste Disposal

The waste material from the preparation line will be conveyed into an overhead hopper (Code 325). This hopper should be located to permit trucks to back under the discharge chute to remove the trimmings. These solid wastes will have to be trucked to the dumps.

The waste water from a beet dehydration plant will be screened to take out the major part of the suspended waste solids. The liquid waste might then be run into available sewers, streams or irrigation ditches, or into seepage ponds, lagoons or waste land, depending upon what is available and upon local or state regulations.

BUILDINGS AND GROUNDS

Buildings and grounds for a beet dehydration plant should conform with the general requirements described in Volume I under "Plant Location" and "Selection of Plant Procedures and Facilities". A minimum of 3 acres of land should be provided for the beet plant depicted herein; more acreage would be advisable in many cases.

Figure 3 shows a suggested plant layout. The various processing steps are located to permit ready expansion if desired. Raw commodity and product storage areas are adjoining to provide flexibility of space as required; if more space is required, expansion away from the plant proper is possible. The entire preparation line may be expanded into the area designated for auto parking. Conveyor drier and bin drier areas may expand away from the building proper as shown in Figure 3. Inspection and packaging operations may expand into the finished product storage space.

The boiler room is shown detached from the buildings. Approximately 25 feet separation is the minimum to obtain lower fire insurance rates. A detached boiler house also affords better accessibility for servicing and repairing the boilers.

The location of the offices, laboratory, rest rooms, and lunch room is only suggestive. These could be rearranged without seriously affecting plant operation.

Floor drains should be provided in the preparation area, particularly under the washers (Codes 221 and 223.9), trimming tables (Code 224), and blancher (Code 227).

CHAPTER IV

COST OF BEET DEHYDRATION FACILITIES

Cost Summary

100 -- RAW MATERIAL PROCUREMENT FACILITIES		
170 -- "Crates, Boxes, & Sacks" (sacks)	$ 7,200	
Total for RAW MATERIAL PROCUREMENT FACILITIES		$ 7,200
200 -- MANUFACTURING OPERATIONS FACILITIES		
210 -- "Raw Material Handling" Equipment	15,315	
220-230 -- "Preparing" Equipment	81,005	
240 -- "Drying" Equipment	208,100	
250 -- "Screening & Inspecting" Equipment	2,660	
260 -- "Packaging & Packing" Equipment	12,770	
270 -- "Warehousing & Shipping" Equipment	6,445	
Total for MANUFACTURING FACILITIES		$326,295
GENERAL FACILITIES		
320 -- "Utilities" Equipment	$ 70,945	
330 -- "Maintenance & Repairs" Equipment & Supplies	15,000	
380 -- "Inspection & Control" Equipment	5,000	
390 -- "Miscellaneous Plant" Equipment	5,700	
400 -- "Automotive" Equipment	3,500	
690 -- "Office & First Aid" Equipment & Supplies . .	5,000	
Total for GENERAL FACILITIES		$105,145
Total for Plant Equipment (TABLE I)		$438,640
Total for Buildings & Grounds (TABLE II)		190,000
Construction Engineering Fees		30,000
TOTAL COST FOR ITEMIZED PHYSICAL FACILITIES FOR BEET DEHYDRATION PLANT		$658,640

Critical Materials in the Equipment for a 100-ton per Day Beet Dehydration Plant

Material	Estimated Total No. of Pounds in Equipment	Percentage of Total Weight of Critical Materials
Iron and Steel	400,000	96.56
Copper	1,800	0.44
Stainless Steel	11,000	2.66
Zinc	400	0.10
Tin	100	0.02
Rubber	900	0.22
	414,200	100.00

Disclaimer Statement

The designation of any manufacturer or brand-name equipment does not imply a specific recommendation by the Department of Agriculture. Such inclusion means only that these particular items have been found satisfactory for the purpose indicated; other sources and items may prove equally satisfactory. Additional information concerning suggested manufacturers of equipment may be found in "Additional Sources of Information" (Volume I, Appendix C).

TABLE I — PLANT EQUIPMENT FOR A 100-TON PER DAY BEET DEHYDRATION PLANT

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
			100 -- RAW MATERIAL PROCUREMENT FACILITIES			
170 -- Crate, Box, and Sack Expense						
	c. Sacks: For handling beets from field to plant	--	Used burlap sacks; 50 pounds capacity	40,000	$ 0.18	$ 7,200
	TOTAL COST OF "RAW MATERIAL PROCUREMENT" FACILITIES					7,200 ~~$144,000~~
			200 -- MANUFACTURING OPERATIONS FACILITIES			
210 -- Raw Material Handling						
211 -- Weighing (at plant)						
	a. Truck scales: To weigh incoming loads of raw material (not required for plants having access to public scales)	Fairbanks Morse Code 6512 (13,700 lbs)	Platform 60' x 10', capacity 50 tons. Equipped with type registering beam. Includes structural steel for timber deck. Cost includes $350 installation charge, and does not include pit	1	3,750	3,750
	b. Pit & housing for scales	--	Estimated cost for constructing pit and housing for scales	-	--	3,000
212 -- Unloading (at plant)						
	a. Lift truck: To handle palletized raw material and other loads within the plant	Yale Model KG 51-T-40-V (7,300 lbs)	Capacity 2 tons, gasoline engine	1	4,080	4,080
	b. Pallets: For handling raw beets within plant	--	Wood; 48" x 60"; double faced	500	4	2,000
213 -- Feeding to line						
	a. Elevator: To serve as dumping point for sacked raw material, and to elevate beets to first washer	FMC 1/ Fig. No. 8657 (700 lbs)	12" wide x 68" discharge height, cleated rubber belt elevator with steel frame; complete with 1/2 h.p. motor drive	1	1,100	1,100
			Sub-total			$ 13,930
Allowance for Freight Charges (factory-made equipment)			- 22,000 lbs. at 5¢/lb.			1,100
Allowance for Installation Charges - 25% of equipment			plus freight cost ($1,135) 2/			285
	Total Cost of "Raw Material Handling" Equipment					$ 15,315
220-230 -- Preparing						
221 -- Washing						
	a. Washer: To wash dirt from beets	FMC Fig. 9331 (2,300 lbs)	43" diameter x 12' long, rotary rod type washer, all-steel construction; with centrally located spray pipe and adjustable discharge baffle; complete with 2 h.p. splash-proof motor drive	1	3,000	3,000
222 -- Preheating						
	a. Elevator: To elevate the beets to the preheater	FMC Fig. 5071 (1,100 lbs)	24" wide x 9' discharge height, Standard Elevator, all-steel construction with steel slat and flight draper carried on side chains; complate with 1 1/2 h.p. constant speed motor drive	1	2,035	2,035
	b. Preheater: To preheat the beets before steam peeling	Custom built 3/ (see Fig. No. 6) (6,500 lbs)	8' o.d. x 6' i.d. x 5' long rotary heater; equipped with direct steam injection heating and geared to rotate at a speed of 1 revolution each 20 minutes; complete with 1 h.p. motor and drive	1	4,300	4,300

1/ Food Machinery & Chemical Corp
2/ Equipment cost based on F.O.B. manufacturer's price plus allowance for freight charges at 5¢/lb.
3/ Southern Regional Research Laboratory (U.S.D.A.) design, as modified and specified by Benner Nawman, Inc.

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
	c. Controls: To regulate and control temperatures in the preheater	Taylor #86RV323 #6VP255 #R89S17 #R41S323 (125 lbs)	Each control set consisting of: Indicating temperature controller Reverse-acting diaphragm valve (1 1/4") Air filter Air reducing valve (1/4")	1	$ 260	$ 260
223 -- Peeling						
223.3 -- Steam peeling						
	a. Steam peeler: To peel beets by steaming of skins.	FMC Fig. 8689 (10,500 lbs)	Continuous high pressure steamer, ASME construction; for max. operating pressure of 100 p.s.i.; with feed elevator, platform for 6' discharge height, 3' extended shell; variable speed, 3 h.p. motor drive; and temp. control instruments	1	$13,625	$ 13,625
223.9 -- Washing						
	a. Washer: To wash off beet skins which have been loosened in steam peeler	FMC Fig. 2085 (1,400 lbs)	Continuous vegetable peeler with rubber-covered rolls; complete with 5 h.p. motor	1	1,975	1,975
224 -- Trimming and inspecting						
	a. Cross conveyor: To convey and distribute peeled beets from washer to trim tables	FMC Fig. 5030 (1,000 lbs)	24" wide x 15' center-to-center, rubber belt conveyor; steel frame construction; belt supported by steel rollers with oilite bearings; complete with 1-1/2 h.p. motor drive	1	1,385	1,385
	b. Trimming and inspecting tables: To convey peeled beets during final trimming and inspection before dicing	FMC Fig. 9318 (4,700 lbs each)	Merry-go-round trim tables consisting of 3 parallel 12" wide x 40' long center-to-center rubber belt conveyors; outer belts for trimming and with divided lanes for trimming, inner belt to be raised so that return side acts as merry-go-round return for overflow from outer belts, top side for conveying trimmed product to discharge point; all steel construction with belts carried on steel rollers with oilite bearings; complete with 3 h.p. motor drive	2	5,455	10,910
226 -- Cutting (dicing)						
	a. Hoppers and elevators:					
	(1) Hoppers: To hold peeled beets for regulating flow during lunch periods, etc.	Custom built	75 cu. ft. capacity, galvanized iron, to fit elevator boot	2	100	200
	(2) Elevators: To elevate trimmed beets to dicers	FMC Fig. 8657 (1,550 lbs each)	24" wide x 13' discharge height, cleated rubber belt elevator with steel frame; complete with 1/2 h.p. motor drive	2	2,210	4,420
	b. Cutters (dicers): To cut prepared beets to 3/16" x 3/8" x 3/8" size	Urschel Model B Dicer (750 lbs each)	Dicer with one extra slicing knife, 6 extra circular knives, and 6 extra cross-cut knives; complete with 2 h.p. splash-proof motor drive	3	1,410	4,230
227 -- Blanching						
	a. Spreader: To load (and spread uniformly) the diced product on the blancher belt	Syntron Model F44 "Twin" (5,200 lbs)	6'10" wide trough of stainless steel; height 35" to back of trough; with magnetic vibratoss	1	2,730	2,730
	b. Blancher: To blanch the diced product before drying	FMC Steam Blancher Fig. 9332 (10,000 lbs)	7' wide x 40' overall length; with stainless steel woven wire draper; with spray section at feed and discharge end; complete with 5 h.p. variable speed drive to provide maximum blanch time of 7 min.	1	12,575	$ 12,575

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
c.	Controls: To regulate and control temperatures in the blancher	Taylor #86RV323 #6VP255 #R89S17 #R41S323 #12EU310 (125 lbs total each set)	Each control set consisting of: Indicating temperature controller Reverse-acting diaphragm valve (1-1/4") Air filter Air reducing valve (1/4") Thermometer (120°F. to 220°F.)	2	$ 275	$ 550
			Sub-total			$ 62,195
	Allowance for Freight Charges (factory-made equipment) - 53,000 lbs. at 5¢/lb.					2,650
	Allowance for Ins tallation Charges - 25% of equipment plus freight cost ($64,645)					16,160
	Total Cost of "Preparing" Equipment					$ 81,005
240 -- Drying						
242 -- Conveyor drying						
242.1 -- Conveying						
b.	Conveyor: To convey blanched product from blancher to dehydrator No. 1	FMC Fig. 5030 (1,700 lbs)	24" wide x 40' center-to-center rubber belt distributing conveyor; steel frame construction; belt supported by steel rollers with oilite bearings; complete with 1-1/2 h.p. motor drive	1	2,400	2,400
b.	Conveyor: To convey blanched product from blancher to dehydrator No. 2	FMC Fig. 5030 (1,400 lbs)	24" wide x 24' center-to-center rubber belt distributing conveyor; steel frame construction; belt supported by steel rollers with oilite bearings; complete with 1-1/2 h.p. motor drive	1	2,000	2,000
b.	Conveyor: To convey blanched product from blancher to dehydrator No. 3	FMC Fig. 5030 (700 lbs)	24" wide x 6' center-to-center rubber belt distributing conveyor; steel frame construction; belt supported by steel rollers with oilite bearings; complete with 1-1/2 h.p. motor drive	1	990	990
242.2 -- Drying						
a.	Dehydrator: To dry diced beets to 9% to 10% moisture	Proctor & Schwartz Continuous Conveyor Dehydrator (65,000 lbs each)	6 Unit "A" and 2 Unit "B" two stage continuous conveyor drier; 75 ft. long, with stainless steel belt; complete with wiper-type feed, motors, starters, temperature controls, instruments, exhaust fans, steam coils, etc.	3	48,000	144,000
242.3 -- Conveying						
a.	Conveyor: To collect and convey the dried product from the dehydrators to the elevator	FMC Fig. 5030 (1,700 lbs)	24" wide x 40' center-to-center rubber belt distributing conveyor; steel frame construction; belt supported by steel rollers with oilite bearings; complete with 1-1/2 h.p/ motor drive	1	2,500	2,500
b.	Elevator: To elevate dried product to bin loading hopper	FMC Fig. 542 (1,400 lbs)	Gooseneck conveyor-elevator; discharge height 10'; 16" wide buckets; complete with 1 h.p. motor drive	1	820	820
			Sub-total			$152,710
	Allowance for Freight Charges (factory-made equipment) - 202,000 lbs. at 5¢/lb.					10,100
	Allowance for Installation Charges - 25% of equipment plus freight costs ($162,810)					40,700
	Total Cost of "Conveyor Drying" Equipment					$203,510
248 -- Bin drying						
248.1 -- Bin loading						
a.	Bins: To hold product during the final drying stage	Custom Built (see Fig. 7)	3' wide x 5' long x 5' high; sheet metal or plywood construction; mounted on casters and equipped with ring for dumping by means of a hoist; metal screen to s erve as false bottom; 12 inch diameter air duct	10	65	650
248.2 -- Bin operating						
b.	Blower: To circulate air through heating coil and drying bins	Sturtevant Silentvane No. 80 Design 10 Class II (875 lbs)	Single width; bottom horizontal discharge; 10,000 c.f.m. at 5" S.P.; including 15 h.p. motor and drive	1	1,000	$ 1,000

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
c.	Heating coils: To heat air going to the drying bins	Aerofin Corp. Type F Non-freeze Coil, Series 80 (400 lbs) ~~each~~)	Bank of coils, 3 rows deep, consisting of one section 24 tube face, 4' tubes (No. 82), plus one section ditto (No. 81)	1	$ 600	$ 600
d.	Ductwork: To carry air from outside of building, conduct it through fans and heating coils, and to each of 8 drying-bin positions	Custom built	Horizontal run laid on floor, 45' long, 10 sq. ft. cross section; 8 outlets on one vertical face, spaced 5' apart, each outlet with transition to 12" dia. collar	1	$ 1,400	1,400
248.3	-- Bin unloading					
a.	Hoist: To elevate the drying bins for dumping of the dried product	Yale Midget King Electric Hoist Model No. IE17H (140 lbs)	Hook type 2000 lb. capacity; 10 ft. lift; 17 f.p.m.; 1 h.p.	1	360	360
			Sub-total			$ 4,010
Allowance for Freight Charges (factory-made equipment)			- 1,400 lbs. at 5¢/lb.			70
Allowance for Installation Charges - 25% of equipment			plus freight cost ($2,030)			510
			Total Cost of "Bin Drying" Equipment			$ 4,590
			Total Cost Conveyor Drying Equipment			203,510
			Total Cost of "Drying" Equipment			$208,100
250	-- Screening and Inspecting					
252	-- Screening					
a.	Magnet: To remove any particles of iron and steel	FMC (Cesco) (20 lbs)	Standard model with steel face plate, 12" wide	1	90	90
b.	Shaker screen: To screen out "fines" from dehydrated product	Link-Belt UP 125 (870 lbs)	2' x 5' unbalanced pulley type; one screen section on single deck; 2 h.p. motor	1	600	600
255	-- Inspecting					
b.	Conveyor-sorter: To convey the product past the final inspection stations	FMC Fig 5031 (1,100 lbs)	30" wide x 10' center-to-center white rubber belt; steel frame construction; 1 h.p. motor	1	1,340	1,340
			Sub-total			$ 2,030
Allowance for Freight Charges (factory-made equipment)			- 2,000 lbs. at 5¢/lb.			100
Allowance for Installation Charges - 25% of equipment			plus freight cost ($2,130)			530
			Total Cost of "Screening and Inspecting" Equipment			$ 2,660
260	-- Packaging and Packing					
261	-- Filling, packing, and sealing					
a.	Elevator: To elevate product to can filling hopper	FMC Fig. 542 (1,000 lbs)	Gooseneck conveyor-elevator, discharge height 6', 16" wide buckets, complete with 1 h.p. motor drive	1	755	755
b.	Filling machine: To deliver the product into No. 10 cans	FMC Handpack Filler Fig. 46-10 (1,500 lbs)	Product is fed into a hopper which rotates along with the can-carrying table; all parts in contact with product are stainless steel; complete with 1 h.p. constant speed motor drive and motor-driven vibrator	1	1,815	1,815
c.	Scales: To check weigh exact amounts into cans	FMC Fig. 2150 (55 lbs. each)	Model 1C-72-05 Detectogram general purpose scale; 10 lbs. capacity	2	115	230
g.	Closing machine (seamer): To seal covers on cans	American Can Co. No. 1 (1,050 lbs)	Semi-automatic machine operated by depressing foot treadle for each seaming operation; includes 1-1/2 h.p. drive	1	850	850

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
	h. Conveyor: To convey filled cans past check weighing stations, and to closing machine	FMC Special attachment to Filler (300 lbs)	7" wide x 8' long, leather belt conveyor	1	$ 500	$ 500
262 -- Case forming, filling, sealing, and marking						
	a. Case branding machine: To print required markings on cases	FMC Fig. 8072 (2,225 lbs)	Automatic machine equipped to handle box shook and flat fibre cases; complete with 1 h.p. motor and variable speed drive	1	1,980	1,980
	b. Case sealing machine: To seal top and bottom flaps on cases	Elliot Model A (4,000 lbs)	Fully automatic with 16' of compression section; complete with 3/4 h.p. motor drive on gluing section and 1/4 h.p. motor drive on compression section	1	3,535	3,535
			Sub-total			$ 9,665
Allowance for Freight Charges (factory-made equipment)			- 11,000 lbs. at 5¢/lb.			550
Allowance for Installation Charges			- 25% of equipment plus freight cost ($10,215)			2,555
	Total Cost of "Packaging and Packing" Equipment					$ 12,770
270 -- Warehousing & Shipping						
271 -- Palletizing						
	a. Pallets: For handling empty cans and filled cases	--	Wood; 48" x 60"; double faced	500	4	2,000
272 -- Warehousing						
	a. Lift truck: To move palletized loads in products warehouse	Yale Model KG 51-T-40-V (7,300 lbs)	Capacity 2 tons; gasoline engine	1	4,080	4,080
			Sub-total			$ 6,080
Allowance for Freight Charges (factory-made equipment)			- 7,300 lbs. at 5¢/lb.			365
Allowance for Installation Charges						None
	Total Cost of "Warehousing & Shipping" Equipment					$ 6,445
	TOTAL COST OF MANUFACTURING OPERATIONS FACILITIES					$326,295
			GENERAL FACILITIES			
320 -- Utilities						
321 -- Water supply						
	a. Water pump: To elevate water from well and to deliver it throughout plant at required pressure	FMC (Peerless) Deep Well Turbine Type Pump (5,300 lbs)	8 stages, 10" M.A. Sheet No. R1096, Curve 1, for 500 g.p.m. with 285' head at 80 p.s.i. delivery pressure; complete with strainer and 40 h.p. motor	1	2,000	2,000
	b. Chlorinator: To treat the water used in the plant to prevent slime formation and to improve plant sanitation	Wallace & Tiernan Type MASVM-A-421 (1,500 lbs)	Consists of chlorinator, booster pump, differential converter, and main line orifice ~~plant~~ plate; converter automatically controls flow of chlorine so that the latter is always proportional to the flow of water; includes ~~installation and~~ piping and electrical connections	1	4,500	4,500
	c. Water well: For supplying sufficient water to meet needs of plant	--	Cost includes digging and casing of well and small housing for pump motor	1	3,000	3,000
322 -- Fuel Supply						
	b. Oil storage tanks: To store oil for approximately 10 days' operation	(Standard) (12,000 lbs each)	15,000 gal. capacity welded steel tank	2	1,500	3,000

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
324 -- Steam supply						
a.	Steam boiler: To supply steam for operation of plant equipment, clean-up, building heating, etc.	Cleaver-Brooks, Series B, Model 20 (25,300 lbs) each)	Four-pass horizontal fire-tube boiler with integral channel iron frame and burner assembly; 200 boiler horsepower rating, 125 p.s.i. design pressure; equipped for No. 6 oil and gas; complete package unit	3	$11,570	$34,710
325 -- Waste disposal						
a.	Sewage screen: To separate solids from water in sewage disposal system	FMC Fig. 1437 North Sewage Screen (8,000 lbs)	Trunnion type; with segment tooth drive screen with precision cut teeth, 6 ft. screen, 20-mesh bronze wire, 400 g.p.m. capacity; complete with steel tank and 3 h.p. motor	1	3,095	3,095
b.	Elevator: To elevate solid wastes from sewage screen to hopper	FMC Fig. 541 (2,100 lbs)	12" wide gooseneck conveyor-elevator with galvanized iron buckets; discharge height 20'; complete with 1 h.p. motor drive	1	880	880
c.	Hopper: To hold solid waste until trucked to dump	Custom Built	10' x 10' x 6' height; with sloping sides and discharge gate; elevated clearance of 12'	1	400	400
			Sub-total			$ 51,585
Allowance for Freight Charges (factory-made equipment) - 17,000 lbs. at 5¢/lb.						5,850
Allowance for Installation Charges - 25% of equipment plus freight cost ($54,035)						13,510
	Total Cost of "Utilities" Equipment					$ 70,945
330 -- Maintenance and Repairs 4/						
a.	Maintenance shop equipment: To maintain plant in proper operating condition; to make necessary repairs	--	Includes welding and cutting equipment; drill presses; cut-off saws; sheet metal cutting facilities; hand tools for carpentry, electrical, and metal work; pipe threading and cutting equipment; miscellaneous supplies	-	--	5,000
b.	Maintenance parts & supplies: Standing inventory of spare parts and maintenance supplies to assure continuous operation of the plant	--	Pipe, sheet metal, fittings, electric motors, equipment parts, welding supplies, etc.	-	--	10,000
	Total Cost of "Maintenance & Repairs" Equipment and Supplies					$ 15,000
380 -- Inspection and Control 4/						
381 -- Laboratory testing						
a.	Laboratory equipment & supplies: To do necessary control testing of processing operations and of finished products	--	Apparatus, supplies, tables, hoods, benches, and other facilities needed for tests and control purposes	-	--	5,000
	Total Cost of "Inspection and Control" Equipment and Supplies					$ 5,000
390 -- Miscellaneous Plant Equipment 4/						
a.	Lunch room: To accomodate up to 50 people at a time	--	--	-	--	4,500
b.	Fire-fighting equipment: For emergency use	--	2 - 300-ft. hoses and reels; 2 emergency showers; 8 5-gal. extinguisher tanks; 12 hand extinguishers; 12 gas masks	-	--	1,200
	Total Cost of "Miscellaneous Plant" Equipment					$ 5,700
400 -- Automotive Equipment						
a.	Truck: For miscellaneous work to keep plant in proper operation	GMC	1-1/2 ton pick-up truck (delivered price)	1	3,500	3,500
	Total Cost of "Automotive" Equipment					$ 3,500

4/ Costs indicated for these items include installation costs

(Table I Continued)

LIST OF FACILITIES

(NOTE: THE MANUFACTURERS LISTED ARE NOT RECOMMENDED OVER OTHER MANUFACTURERS OF SIMILAR EQUIPMENT)

Code Number & Operating Steps	Equipment Needed & Function	Acceptable Model (& Ship. Wt.)	Description of Equipment	No.	Cost Per Unit	Approximate Total Cost
690 -- Miscellaneous Administrative Supplies and Facilities 4/						
a.	Office furniture, supplies, and first-aid facilities: For bookkeeping, payrolls, business transactions; personnel work; first aid	--	--	-	--	$ 5,000
	Total Cost of "Miscellaneous Administrative Supplies & Facilities"					$ 5,000
	TOTAL COST OF "GENERAL" FACILITIES					$105,145

TABLE II

BUILDING AND GROUNDS FOR A BEET DEHYDRATION PLANT

	Building & Grounds: Suitable building and grounds for the beet dehydration plant	--	Includes: land; and a building complete with industrial lights, utility and sewer lines within the building, toilet facilities, and loading ramps (or platform) Building - 38,000 sq. ft. at $5/sq. ft.			$190,000
	TOTAL COST OF BUILDING AND GROUNDS					$190,000

TABLE III

OPTIONAL EQUIPMENT FOR A BEET DEHYDRATION PLANT

321 -- Water supply						
a.	Diesel engine: For st and-by use for operating the well water pump	Fairbanks-Morse Co.	Diesel engine complete with fuel tank and connecting gears for attaching to well water pump. Cos t for this standby service is in addition to the cost of pump equipment listed	1	$ 1,500	$ 1,500
394 -- Miscellaneous						
a.	Hand trucks, auxiliary tables, and other similar equipment	--	--	-	--	5,000
	TOTAL COST OF "OPTIONAL" FACILITIES					$ 6,500

Chapter V

PRODUCTION COSTS FOR A 100-TON PER DAY BEET DEHYDRATION PLANT

Table I -- Summary of Cost of Producing Dehydrated Beets
(Assuming Different Raw Material Costs and Shrinkage Ratios)

Overall-shrinkage ratio of:	10 to 1	13 to 1	15 to 1
Output of finished product per day (lbs.)	20,000	15,400	13,340
	Production Cost per Pound of Product		
Processing Cost - See Table II	$0.2328	$0.2681	$0.2954
Assumed cost per 100 tons of Raw Material Entering Processing Line			
At $10 a ton $1,000 a day	$0.0500	$0.0650	$0.0750
15 1,500	0.0750	0.0975	0.1125
20 2,000	0.1000	0.1300	0.1500
25 2,500	0.1250	0.1625	0.1875
30 3,000	0.1500	0.1950	0.2250
40 4,000	0.2000	0.2600	0.3000
Assumed Production Cost 1/ at Various Costs of Raw Material			
At $10 a ton	$0.2828	$0.3331	$0.3704
15	0.3078	0.3656	0.4079
20	0.3328	0.3981	0.4454
25	0.3578	0.4306	0.4829
30	0.3828	0.4631	0.5204
40	0.4328	0.5281	0.5954
Estimated Depreciation Charge (See Table X)			
Assuming plant operates only on beets:			
Accelerated write-off	$0.0500	$0.0650	$0.0750
Normal life expectancy	0.0167	0.0216	0.0250
Assuming plant operates half time on another product:			
Accelerated write-off	$0.0250	$0.0325	$0.0375
Normal life expectancy	0.0083	0.0108	0.0125

1/ Exclusive of Depreciation Charges

Table II -- Processing Cost Summary Using 3 Different Overall Shrinkage Ratios
(Depreciation not included)
(Beet Dehydration Plant)

	10 to 1 (Low)	13 to 1 (Average)	15 to 1 (High)
Input - lbs. per day raw commodity	200,000	200,000	200,000
Output - lbs. per day net yield of diced beets	20,000	15,400	13,340
Total daily processing cost based upon cost calculation using a 13 to 1 overall shrinkage ratio	$4,125	$4,125	$4,125
Adjustment for Labor -			
Deduct 15% of cost of screening, inspecting, packaging, warehousing & shipping labor ($433)			- 65
Add 30% of cost of screening, inspecting, packaging, warehousing & shipping labor	+ 260		
Adjustment for packaging supplies			
Deduct total packaging supply cost based on a 13 to 1 shrinkage ratio	- 900		-900
Add cost applicable to shrinkage ratio (pounds x $0.0585)	+ 1,170		+ 780
Adjusted cost 1/	$4,655	$4,125	$3,940
Cost per pound of net product	$0.2328	$0.2681	$0.2954

1/ For purposes of this illustration, it is assumed that all costs per day would be constant for the various yields except the two cost items adjusted. In actual practice, however, costs would be more variable as a result of the different shrinkage ratios.

Table II-A -- Calculation of Unit Costs of Processing for Various Shrinkage Ratios
(Assuming constancy of cost except as calculated in Table II)
(Beet Dehydration Plant)

	10 to 1		13 to 1		15 to 1	
	Daily Cost	per Pound	Daily Cost	Per Pound	Daily Cost	Per Pound
Pounds output per day	20,000		15,400		13,340	
Raw material procurement	$ 77	$0.0039	$ 77	$0.0050	$ 77	$0.0058
Direct labor cost	2,183	0.1091	1,923	0.1250	1,858	0.1392
Manufacturing expense	2,118	0.1059	1,848	0.1201	1,728	0.1296
Packaging supplies and expenses	1,170	0.0585	900	0.0585	780	0.0585
Other manufacturing expense	948	0.0474	948	0.0616	948	0.0711
General and Administration	277	0.0139	277	0.0180	277	0.0208
Total	$4,655	$0.2328	$4,125	$0.2681	$3,940	$0.2954

Table III -- Processing Cost Summary for Beet Dehydration Plant

Account No.		Table No. Reference	Processing Cost Per 24-hour Operating Day	Processing Cost Per Pound Dry Product
Output of Finished Product Per Day (13 to 1 overall shrinkage ratio)		II	15,400 pounds	
800 -- Total Cost of Finished Product (exclusive of depreciation and raw material purchase price)			$4,125	$0.2681
100 -- Raw Material Cost (exclusive of purchase price)		IV	$ 77	$0.0050
120	- Buying Expense		47	0.0030
180	- Federal-State Inspection		30	0.0020
200 -- Direct Labor		V	$1,923	$0.1250
210	- Raw Material Handling		121	0.0079
220-230	- Preparing		1,256	0.0817
240	- Drying		113	0.0073
250	- Screening and Inspecting		214	0.0139
260	- Packaging and Packing		173	0.0112
270	- Warehousing and Shipping		46	0.0030
300 -- Manufacturing Expense			$1,848	$0.1201
310	- Indirect Labor	VII	171	0.0111
320	- Utilities	VIII	382	0.0248
330	- Maintenance and Repairs	IX	188	0.0122
340	- Depreciation (not included)	X	---	------
350	- Taxes and Insurance	XI	83	0.0054
370	- Packing Supplies and Expenses	XII	900	0.0585
380	- Inspection and Control	XIII	74	0.0048
390	- Miscellaneous Plant Expenses	XIV	50	0.0033
600 -- General & Administrative Expenses		XV	$277	$0.0180
610	- Office Salaries		159	0.0103
620-690	- Miscellaneous Expenses		118	0.0077

Table IV -- Raw Material Cost (Account 100)
(Beet Dehydration Plant)

Account No.			Annual Cost	Cost per Operating Day 1/
100	-- Total Raw Material Cost (excluding purchase price of raw material)		$7,728	$77
110	- Purchase price		-----	---
	The purchase price of raw material is not included here as a cost. See Table I for calculation of raw material costs at various purchase prices per ton			
120	- Buying Expense		4,728	47
	Salary of field agent	$7,000		
	6 months 2/	$3,500		
	Social security, workmen's compensation and unemployment insurance - 6.52%	228		
	Expenses - travel, telephone, etc. (estimated)	1,000		
150	- Transportation and weighing costs		-----	---
	(Included in Table I as part of assumed prices paid for raw material)			
160	- Storage		-----	---
	No outside storage costs are assumed for this study. There may be many instances, however, where storage costs may be incurred and will be an item of expense			
170	- Crate, box, and sack expense		-----	---
	Cost not included here. On the basis of a cost of $7,200 for sacks and a three-year life with good care, the annual cost would be $2,400			
180	- Federal-State Inspection		3,000	30
	One inspector 100 days @ $30			

1/ Assumed to be 100 days a year

2/ Because of short operating season on beets, it is assumed only 1/2 of field man's salary is charged to beets

Table V -- Direct Labor Cost Summary (Account 200)
(Beet Dehydration Plant)

Account No.		Per 24-Hour Operating Day: Direct Labor Cost Per Day 1/	Add Labor Expense 21% 2/	Total Direct Labor Cost
200	-- Total Direct Labor Cost	$1,589	$334	$1,923
210	- Raw Material Handling	100	21	121
220-230	- Preparing	1,038	218	1,256
240	- Drying	93	20	113
250	- Screening and Inspecting	177	37	214
260	- Packaging and Packing	143	30	173
270	- Warehousing and Shipping	38	8	46

1/ From Table VI

2/ In addition to the "Direct Labor Cost per Day" the following items are additional costs that must be paid by the employer:

	Percentage to apply to calculated labor cost
a. Overtime - All hours per week over 40 are paid for at one-and-one-half times the basic rate. The work week is 48 hours, making 8 hours to be paid at overtime. Thus the employee receives 12 hours pay for 8 hours. For the week he gets 52 hours pay for 48 hours work (52/48) - 1.0 = 0.08333	8.33%
b. Swing and night shift differential may amount to 5¢/hr. This may give an average differential of 2.5% on 3-shift basis	2.50
c. Social security - Paid by employer	1.50
d. Unemployment insurance - For a new, highly seasonal business, the rate would be	2.70
e. Workmen's compensation	2.32
f. Vacation pay - none calculated. A typical union contract provides for vacation with pay after the end of the year in which an employee has worked 1600 hours or more. On a 100-day operation, the total would be only 800 hours	---
g. Holiday pay - Practices vary with respect to payment for holidays which occur during work week. Since some union contracts provide for such pay, even when the employee does not work, allowance is made here for such cost	3.00
Round off to	21%

Table VI -- Direct Labor Cost Work Sheet (Account 200)
(Beet Dehydration Plant)

Account No.	Operation	Number of Employees per Shift		Hourly Rate of Pay		Total Hours per Shift	Total Cost per Shift	Total Cost per 24-hour Operating Day
		Men	Women	Pay Bracket	Amount			
200	-- TOTAL DIRECT LABOR COST	12	57				$529.60	$1,588.80
210	-- Raw Material Handling . . .	3 1/2	-				33.20	99.60
	Foreman 1/	1/2		1	$1.50	4	6.00	
	Operating lift truck and assisting feeding to line	1		3	1.20	8	9.60	
	Feeding line from bags	2		4	1.10	16	17.60	
220-230	- Preparing	1 1/2	46				346.00	1,038.00
	Foreman 1/	1/2		1	1.50	4	6.00	
	Floorlady		1	5	1.00	8	8.00	
	Trimming and inspecting		45	6	.90	360	324.00	
	Cleaning up	1		5	1.00	8	8.00	
240	-- Drying	3	-				31.20	93.60
242	-- Conveyor drying	1 1/2					15.60	
	Foreman 2/	1/2		1	1.50	4	6.00	
	Operating	1		3	1.20	8	9.60	
248	-- Bin drying	1 1/2					15.60	
	Foreman 2/	1/2		1	1.50	4	6.00	
	Handling bins	1		3	1.20	8	9.60	
250	-- Screening and Inspecting . .	1 1/4	6 1/2				59.00	177.00
	Foreman 3/	1/4		1	1.50	2	3.00	
	Floorlady 4/		1/2	5	1.00	4	4.00	
	Attending screen and cleaning up	1		4	1.10	8	8.80	
	Inspecting		6	6	.90	48	43.20	
260	-- Packaging and Packing . . .	1 1/2	4 1/2				47.60	142.80
	Foreman 3/	1/2		1	1.50	4	6.00	
	Floorlady 4/		1/2	5	1.00	4	4.00	
	Feeding empty cans		1	6	.90	8	7.20	
	Filling cans		1	6	.90	8	7.20	
	Check weighing cans and placing in cases		1	6	.90	8	7.20	
	Sealing cans		1	6	.90	8	7.20	
	Sealing, branding, and stacking cases	1		4	1.10	8	8.80	
270	-- Warehousing and Shipping . .	1 1/4	-				12.60	37.80
	Foreman 3/	1/4		1	1.50	2	3.00	
	Operating lift truck, warehousing, shipping	1		3	1.20	8	9.60	

1/ One foreman for raw material handling and preparing
2/ One foreman for all drying operations
3/ One foreman for screening & inspecting, packaging, and warehousing & shipping
4/ One floorlady for screening & inspecting, and packaging

Table VII -- Indirect Labor (Account 310)
(Beet Dehydration Plant)

Account No.		Number of Employees	Assumed Yearly Rate	Hourly Rate	Total No. of Hours Employed Annually 1/	Yearly Cost	Cost per Operating Day
310 -- Total Indirect Labor						$17,090	$171
	Year-round employees					$13,315	
	Production Supt.	1	$7,000	-	- $7,000		
	Shift Superintendents	2	6,000	-	- 12,000		
	Guards	---	-----	-	- 6,000 2/		
	Labor expense - 6.52% 3/				1,630		
					26,630		
	One-half chargeable to beets ##/				13,315		
	Seasonal employees					3,775	
	Boiler operator and oiler	3		$1.30	2,400 $3,120		
	Labor expense - 21% ##/				655		

1/ 100 days, 8 hours a day - 800 hours for each employee

2/ The estimate of $6,000 for guard service is based upon an assumption of 16 hours of guard service per day for each day of the year. The number of guards actually employed will depend upon how the guard time is divided among the guards. For example, in a week of 7 days, 16 hours a day, or a total of 112 hours, three guards could divide the time so that each would work about 37 hours

3/ Social security 1.50%
Unemployment insurance 2.70%
Workmen's compensation 2.32%
6.52%

##/ See Table V for analysis of 21% labor expense

Table VIII -- Utilities (Account 320)
(Beet Dehydration Plant)

Account No.		Cost per Operating Day
320	-- Total Daily Cost of Utilities	$382
321	- Water supply	---
	500 gallons a minute is estimated need of plant. It is assumed that water will be pumped from company's own well, so cost of pumping is included in cost of power	
322	- Fuel - Boiler	292
	200 horsepower boiler rated at 60 gal per hour fuel oil - 3 boilers 3 x 60 = 180 gallons per hour Based on a 75% load on boilers, fuel oil cost would be: 180 x .75 = 135 gal/hour Gallons per day (135 x 24) = 3,240 Cost per day - 3,240 gallons @ 9¢/gal = $292.00	
	It is assumed that the fuel oil used would be Bunker C grade (About 150,000 BTU per gallon)	
323	- Electric power	50
	Motors - 275 h.p.	
	(746 watts per h.p. and 75% use and efficiency factor) 275 x .746 x .75 = 155 k.w.	
	Lights (estimated) . . . . . 50 k.w.	
	Total electric power . . . 205 k.w.	
	Cost per hour @ 1¢ per k.w.h. . . $2.05 Cost per 24-hour day $50.00	
325	- Waste disposal	40
	Garbage disposal - 20 tons of "wet waste" per day at $2.00 a ton disposal cost $40	
	Sewerage charges -(No cost) - Assumed disposal in rural area	

Table IX -- Maintenance and Repairs (Account 330)
(Beet Dehydration Plant)

	Total No. of Employees	Hourly Rate Pay Bracket	Hourly Rate Amount	Hours Worked Process Season 1/	Hours Worked Off Season 2/	Total per Employee	Hours for Group	Total Cost Per Year
Labor								
Head mechanic	1	1	$1.50	800	360	1,160	1,160	$1,740
Shift mechanics & oilers	3	2	1.30	800	360	1,160	3,480	4,524
Maintenance mechanic	1	3	1.20	800	360	1,160	1,160	1,392
Sub-total	5							$7,656
Add labor expense (15%) 3/								1,148
						Labor Cost		$8,804
Cost of Supplies and Replacements								
Estimated (for entire year)								10,000
Total Cost of "Maintenance and Repairs" for a year								$18,804
Cost per operating day ($18,804/100)								$188

1/ 100 days, 8 hours a day = 800 hours

2/ 9 weeks, 40 hours a week = 360 hours. It is assumed that the mechanics will be employed for maintenance and repair work to make a total of 6 months' employment. (See Table VII, footnote 3/.)

3/ Labor expense during processing season 19.37%

Night shift differential: 2 mechanics out of 5 on night shift. At average hourly rate of $1.32, 5¢ an hour differential (0.05)(2)/(1.32)(5)	1.52%
Social security	1.50
Unemployment insurance	2.70
Workmen's compensation	2.32
Vacation pay (included in time for off-season)	----
Holiday pay (see Table V)	3.00
Overtime - 52 hours pay for 48 hours work (see Table V) . .	8.33

Labor expense during off-season 6.52%

Social security	1.50%
Unemployment insurance	2.70
Workmen's compensation	2.32
Vacation and holiday pay included in regular 40-hour week .	----

Calculation of labor expense percentage to apply:

(800 hours with 19.37%) 800 x 0.1937 = 154.96

(360 hours with 6.52%) 360 x 0.0652 = 23.47

178.43 178.43/1,160 = 15.38%

Table X -- Depreciation (Account 340)
(Beet Dehydration Plant)

Depreciation is not included as a cost because of the uncertainty of the write-off period that may be allowed. (See "Business Consideration" in Volume I.) The depreciation charges that would be incurred in this plant are calculated below for two possible write-off periods and for two different assumptions: (1) The plant operates only on beets for 100 days, and (2) The plant operates one-half year on another product so that beets take only 1/2 of annual depreciation charge.

1. Assuming normal life expectancy and probable useful lives (as given in Bulletin F, U.S. Treasury Dept. Bureau of Internal Revenue)

Property Item	Original Cost 1/	Estimated 10% Salvage Value	Cost to be Depreciated	Useful Life (years)	Annual Depreciation Charge
Buildings and Grounds 2/	$195,000	$19,500	$175,500	50	$ 3,510
Burlap sacks	7,200	-----	7,200	3	2,400
Equipment	456,440	45,650	410,790	15	27,390
Total	$658,640	$65,150	$593,490		$33,300

Depreciation Charges:

Per operating day (on beets only) ($33,300/100) $333

Assuming plant operates half time on another product ($33,300/100/2) . . $166

	Operation only on beets	Half time operation on another product
Per lb. of product at 10:1	($333/20,000) = $0.0167	($166/20,000) = $0.0083
Per lb. of product at 13:1	($333/15,400) = 0.0216	($166/15,400) = 0.0108
Per lb. of product at 15:1	($333/13,340) = 0.0250	($166/13,340) = 0.0125

2. Assuming 5 year write-off of 75% of capital investment

Total capital investment	$658,640
Less burlap sacks with 3-year life	7,200
	$651,440
75% to be written off	$488,580
Annual charge ($488,580/5)	$ 97,700
Add depreciation on sacks	2,400
Total depreciation charge	$100,100

Depreciation Charges:

Per operating day (on beets only) ($100,100/100) $1,001

Assuming plant operates half time on another product ($100,100/100/2) $ 500

	Operation only on beets	Half time operation on another product
Per lb. of product at 10:1	($1,001/20,000) = $0.0500	($500/20,000) = $0.0250
Per lb. of product at 13:1	($1,001/15,400) = 0.0650	($500/15,400) = 0.0325
Per lb. of product at 15:1	($1,001/13,340) = 0.0750	($500/13,340) = 0.0375

1/ Includes Engineering Construction fees (Building and Grounds $5,000; Equipment $25,000)

2/ Includes value of land

Table XI -- Taxes and Insurance (Account 350)
(Beet Dehydration Plant)

Account No.		Cost per Operating Day
350 -- Taxes and Insurance Expense		$83
For purposes of this estimate, taxes and insurance on property are combined.		
Estimated cost of facilities	$660,000	
Taxes and insurance at 2 1/2%	16,500	
Charge one-half to beets	$ 8,250	
Cost per operating day ($8,250/100)		$82.50

Table XII -- Packing Supplies and Expenses (Account 370)
(Beet Dehydration Plant)

Account No.		Cost per Operating Day
370 -- Total Packing Supplies and Expenses		$899
Cans		
Allowing 2 3/4 pounds of product per No. 10 can		
15,400/2.75 = 5,600 cans per day @ $99 per M		$554
Cases		
934 per day (6 cans per case) @ $299.25 per M		280
Supplies		
Straps, glue, recipe sheets, etc. @ 1¢ a can		56
Allowance for losses (1% of $890)		9

Table XIII -- Inspection and Control (Account 380)
(Beet Dehydration Plant)

Account No.			Annual Cost	Cost/Operating Day
380 -- Total Cost, Inspection and Control			$7,389	$74
Salaried Employees:				
Quality Control Technologist		$6,000		
Add Labor expense (6.52%)		390		
		$6,390		
One-half charged to beets			$3,195	
Hourly Employees				
3 laboratory technicians @ $1.10/hr (2,400 hrs)		$2,640		
Labor expense (21%)		554	3,194	
Supplies & Other Miscellaneous Expenses			1,000	

Table XIV -- Miscellaneous Plant Expenses & Income (Account 390)
(Beet Dehydration Plant)

Account No.	Cost/Operating Day
390 -- Miscellaneous Plant Expenses	$50
391 - Lunch room operation - Assumed that sales of meals would offset the lunch room expense	
393 - Sale of trimmings, fines, etc. The flowsheet indicates that about 1,600 pounds of "rejects" and "fines" will be removed from the dried product per day. This cost estimate does not assume any return from the sale of such material, although it possibly could be sold as feed.	
394 - Other miscellaneous costs (estimated)	$50

Table XV -- General and Administrative Expense (Account 600)
(Beet Dehydration Plant)

Account No.	Cost/Operating Day
Estimated at 4% of a production cost (of 45¢/lb.)	$277
(15,400 x 45¢ x 4%) = $277	
Annual cost ($277 x 100)	$27,700

This estimate is consistent with World War II experience when dehydrators reported General and Administrative Expense ranging from 1% to 15% of total production cost, and averaging between 4% and 5%. This annual cost might be made up as follows:

610 - Salaries	General manager	$10,000		
	Office manager	6,000		
	Personnel officer	4,800		
	Clerks (3 @ $3,000)	9,000	$29,800	
	Labor expense (6.52%)		1,940	$31,740
620-690 - Other expenses				23,660
				$55,400
One-half charged to beets				$27,700

CHAPTER VI

SUMMARY OF CAPITAL AND CREDIT REQUIREMENTS FOR A 100-TON PER DAY BEET DEHYDRATION PLANT

Fixed Capital and Credit Requirements:			
Plant Equipment		$438,700	
Buildings and Grounds		190,000	
Construction Engineering Fees		30,000	
6-Month General Expense: (From "Production Costs")			
From Table IV - Raw Material Procurement . .	$ 4,800		
From Table XIII - Inspection & Control . .	4,800		
From Table XV - General Administration	27,700	37,300	$695,000
Operating Capital and Credit Requirements:			
Estimated Advance Payments to Growers, Insurance, Utilities, etc.		$ 25,000	
75-day Operating Costs ($6,930/operating day) 1/		520,000	
25-day Inventory of Manufacturing Supplies (exclusive of raw commodity) ($900/operating day)		22,500	567,500
Sub-total			$1,263,500
General Contingency Fund:			
Equivalent to approximately 10% of Estimated Capital Requirements			126,500
**ESTIMATED TOTAL CAPITAL AND CREDIT REQUIREMENTS			$1,390,000**

1/ Based on 15,400 lbs. dehydrated beets (diced) per day at an approximate cost of 45¢/lb.

FIG. 1 USUAL PLANTING AND HARVESTING PERIODS FOR TABLE BEETS IN PRINCIPAL PRODUCING STATES

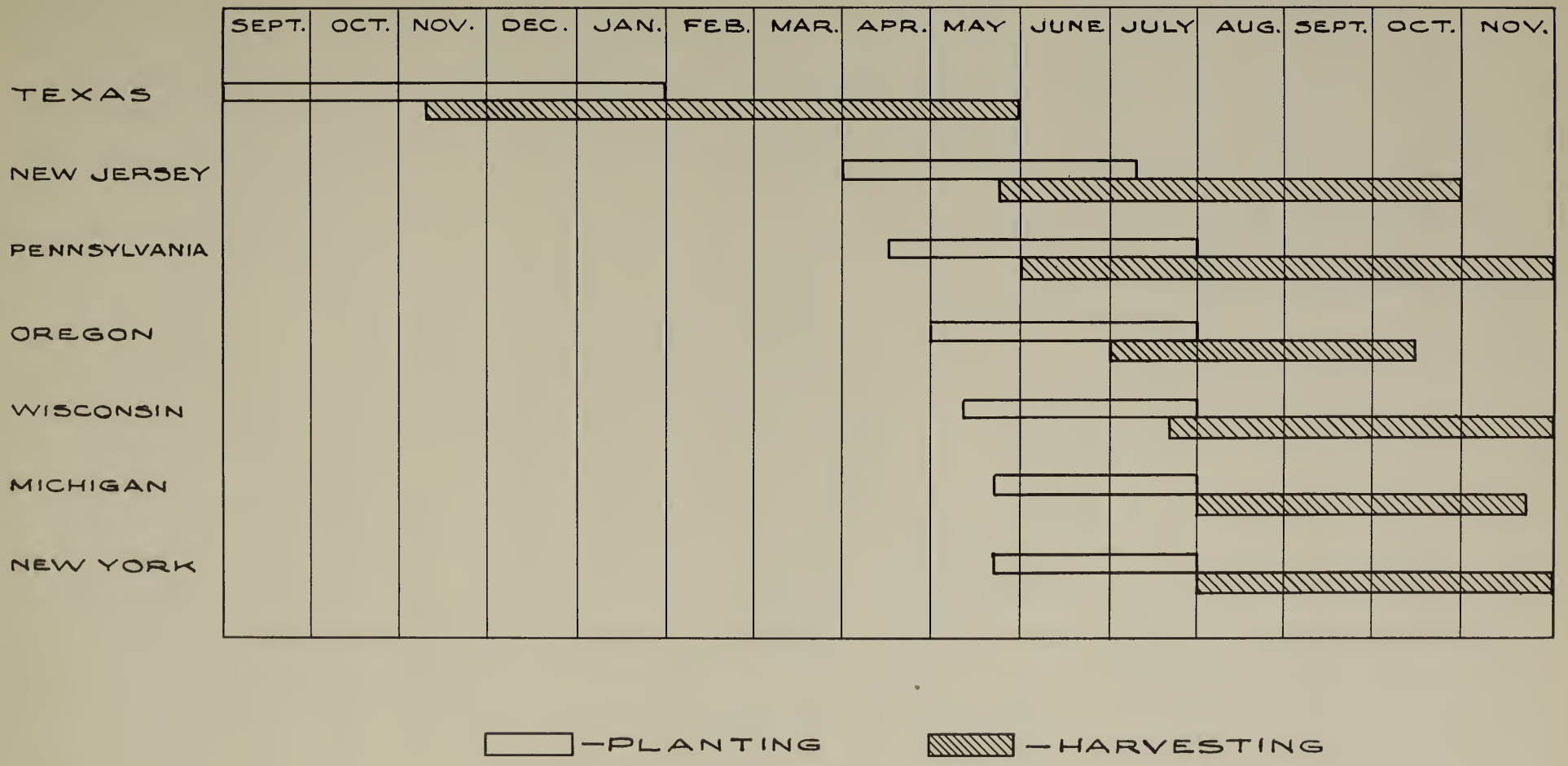
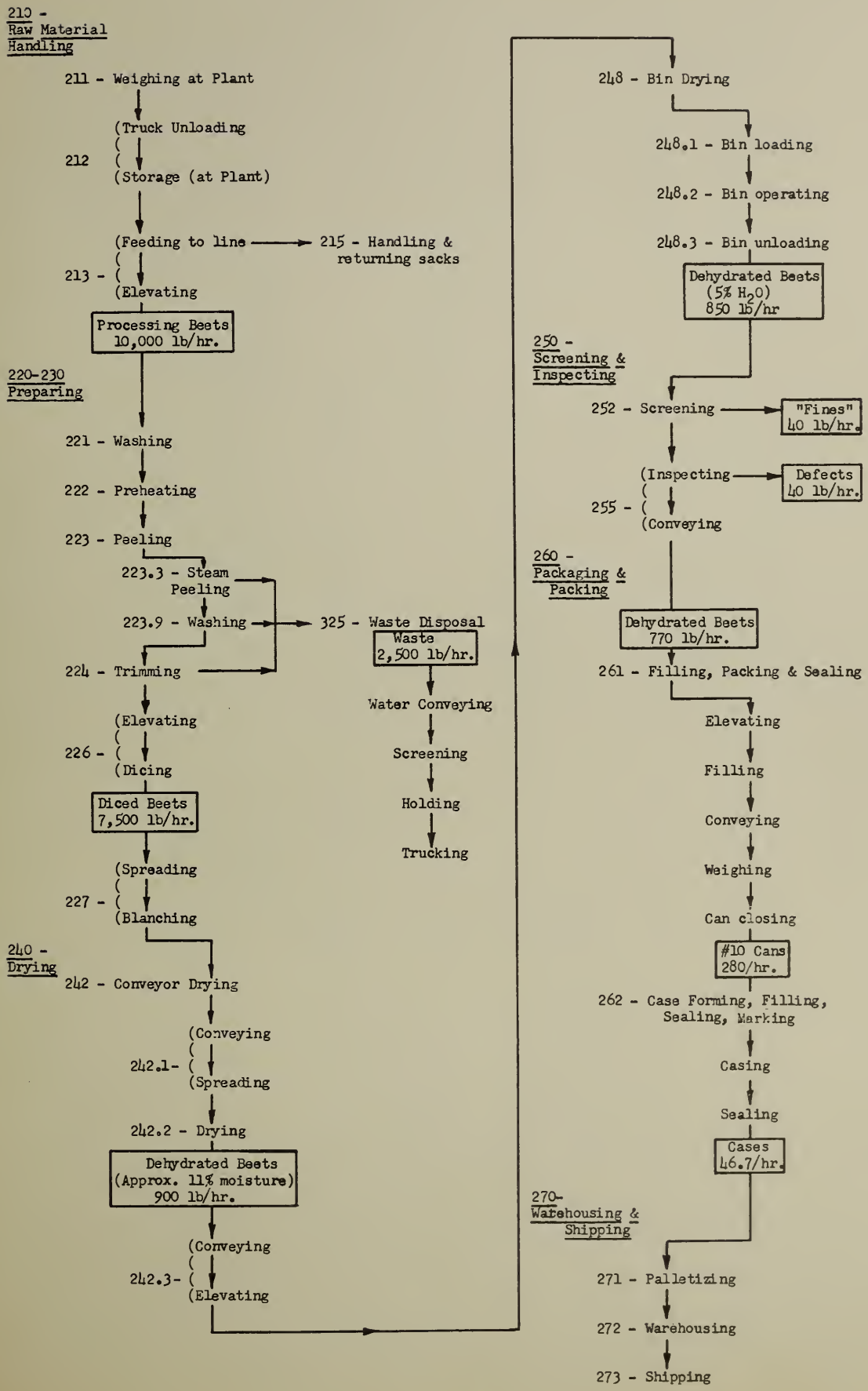


FIGURE 2

FLOW SHEET FOR BEET DEHYDRATION

Capacity 100 Raw Tons per Day



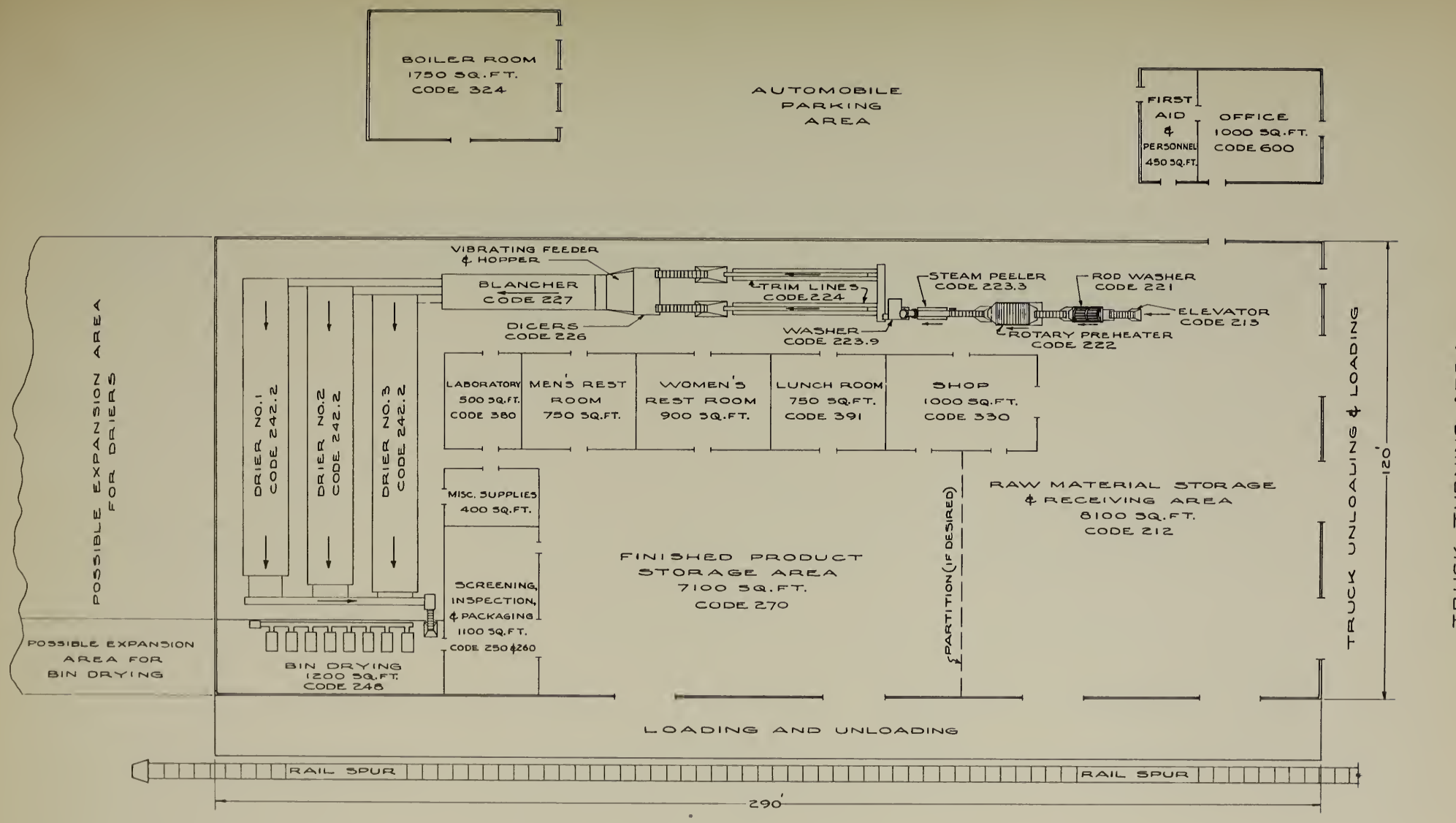
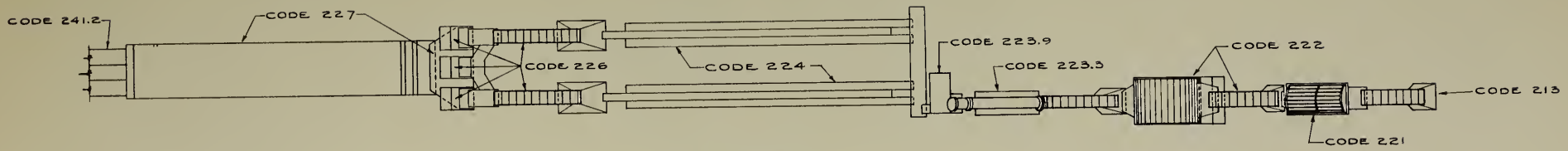


FIGURE 3

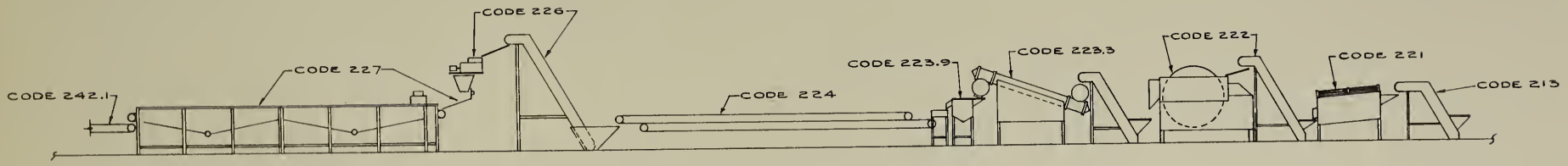
PROPOSED FLOOR PLAN FOR BEET DEHYDRATION PLANT

AREA APPROXIMATELY 38,000 SQ.FT.

0 5 10 15 20FT.



PLAN



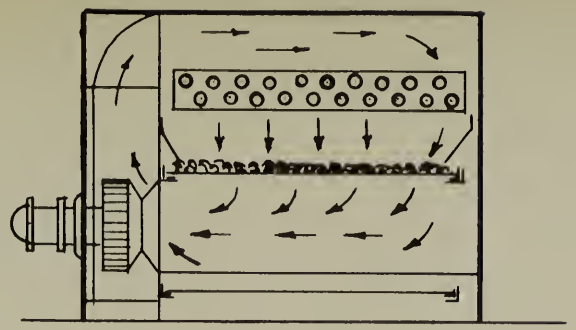
ELEVATION

LEGEND

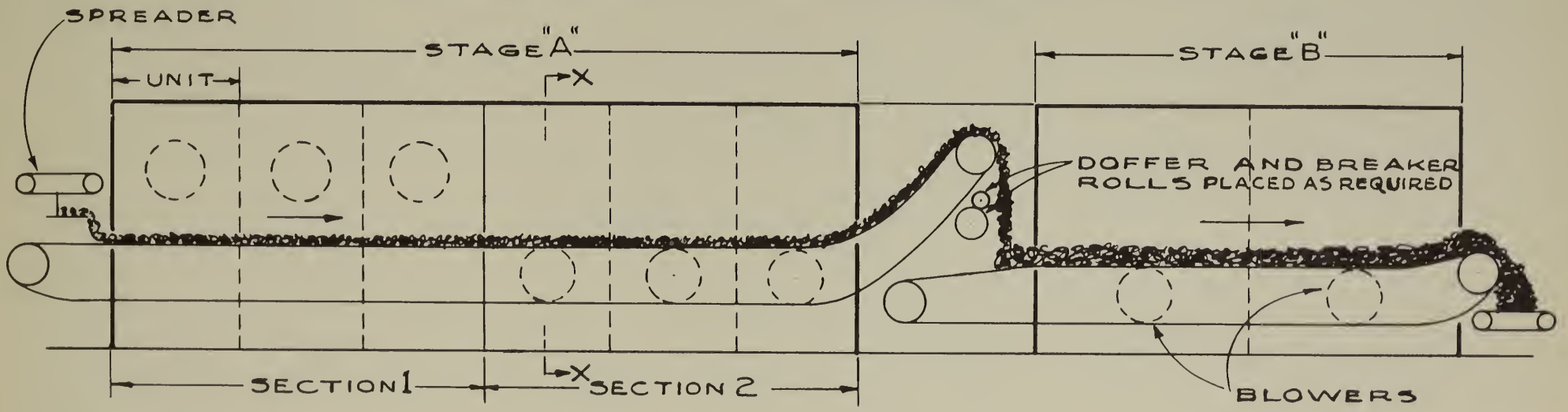
CODE 213 ELEVATOR
221 WASHER
222 PREHEATER AND ELEVATOR
223.3 STEAM PEELER
223.9 WASHER
224 TRIMMING BELTS
226 DICERS AND ELEVATORS
227 BLANCHER AND SPREADER
241.2 CONVEYORS

FIGURE 4

PREPARATION LINE FOR BEET DEHYDRATION PLANT



CROSS-SECTION THROUGH UNIT "XX"



ELEVATION

FIGURE 5

SKETCH OF TYPICAL CONVEYOR DEHYDRATOR

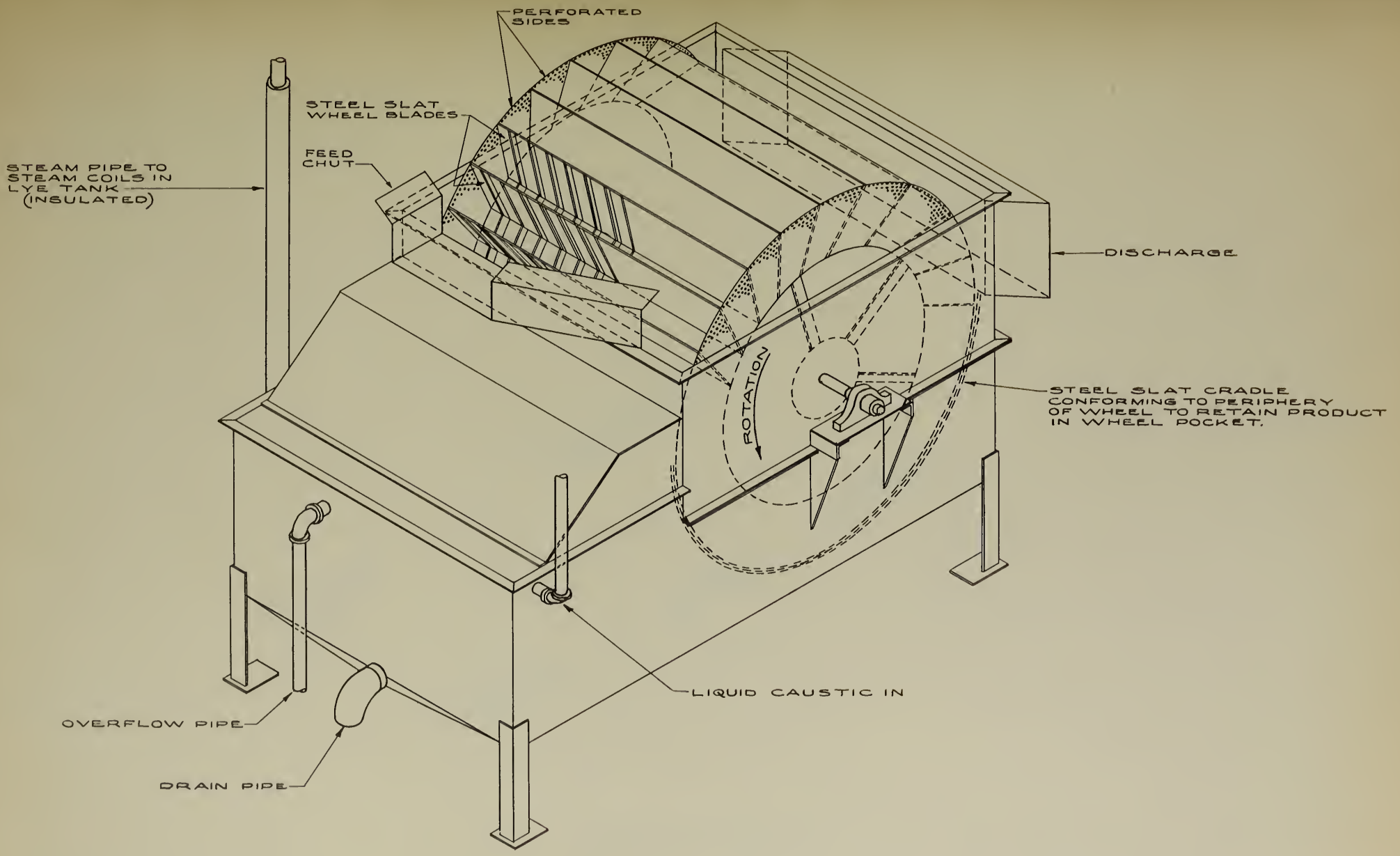


FIGURE 6

ISOMETRIC SKETCH OF ROTARY LYE PEELER.

(CODE 223.2)

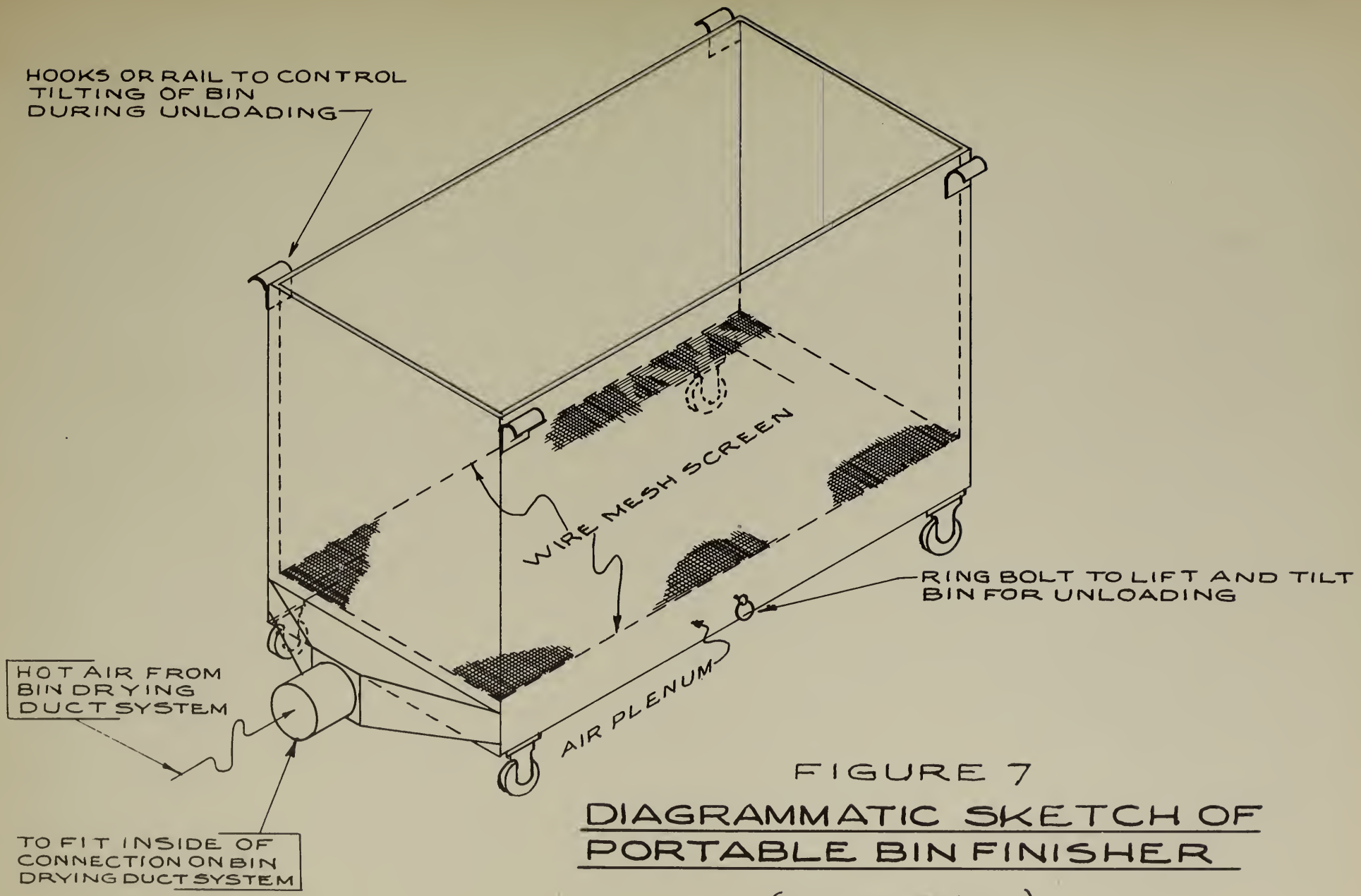


FIGURE 7

DIAGRAMMATIC SKETCH OF PORTABLE BIN FINISHER

(CODE 248.1)

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